OSTEOLOGY OF A SPERM WHALE *PHYSETER MACROCEPHALUS* (LINNAEUS) FROM CENTRAL QUEENSLAND

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The osteology of a subadult, male sperm whale (12.2m) collected from the central Queensland coast is described. Its mean vertebral length (MVL) is compared with a male specimen from the Japanese coast. There is no appreciable difference in vertebral proportions, particularly in the caudal region, between these specimens from the Northern and Southern Hemispheres. □ *Sperm whale, Physeter macrocephalus, osteology.*

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A male sperm whale (12.2m) stranded at Joskeleigh Beach via Keppel Sands (150°48'E, 23°19'S) on 3 Oct. 1995, and died the following day. A Queensland Museum (QM) team arrived at the site on 6 Oct. (Fig. 1). The carcass was flensed and the skeleton collected. The specimen is registered as QMJM11149.

DESCRIPTION

TEETH. Three vestigial maxillary teeth (others were almost certainly present but were lost during flensing) as well as the mandibular teeth were collected (Fig. 2; Table 1). There are 23 right and 23 left mandibular teeth. Beale (1839) counted 24-24 in a specimen from Hull, England. Flower (1869) examined several specimens in the Museum of the Royal College of Surgeons in London and recorded counts of 20-21 (many teeth were worn and perhaps some were lost), 23-24 and 26-26. Omura et al. (1962) counted 24-24 in a Japanese specimen. One of the first mandibular teeth of QMJM11149 was prepared in section according to Lockyer (1981) and the age estimated at 20 years compared with 32 for the 13.8m male specimen described by Omura et al. (1962).

SKULL. The skull, mandible and hyoid structures [from Omura et al. (1962)] are illustrated in Figs 3 & 4A (measurements, Table 2).

VERTEBRAE. The vertebral formula is C7; D11; L8; Ca25 = 51 compared with C7; D11; L8;

FIG. 1. Sperm whale at Joskeleigh Beach, central Qld coast, 6 Oct., 1995.

Ca24 = 50 for the Tasmanian and Japanese specimens described by Flower (1869) and Omura et al. (1962) respectively. Vertebrae are illustrated laterally in Fig. 5A-E. Fusion of C2-7, characteristic of the species, is demonstrated. A minor developmental anomaly in the spinous process of L6 is evident. It is elongated and its tip has failed to fuse.

FIG. 2. Teeth of QMJM11149. Mandibular teeth from right side in upper row and left in lower row. The three vestigial maxillary teeth are shown separately in the lower right. (Scale = 1m)

The vertebral measurements and the mean vertebral length (MVL) of the Japanese specimen (Omura et al., 1962), are contained in Table 3. MVL = $(a \times b \times c)^{1/3}$ where a, b and c represent the breadth, height and length respectively, of the centra. It was used by Omura (1971) when comparing different baleen whale species. We see no objection to the application of this formula to sperm whales. A comparison between the MVL of QMJM11149 and the Japanese specimen is shown in Fig. 6. (Some difficulty was experienced in co-relating measurements in the cervical vertebrae and, accordingly, those of QMJM11149 have been omitted.)

There are eleven chevrons (Fig. 5F; Table 3). Despite careful dissection, no pelvic bones were recovered, however, a bony structure considered to be a rudimentary femur (Fig. 4B; Table 3) was collected.

RIBS AND STERNUM. There are eleven pairs of ribs (Figs 4C & 7; Table 4). The central foramen in the sternum is noted in the descriptions by Flower (1869) and Omura et al., (1962) and in QMJM9920 (this study). The distal sternal elements in the above specimens show considerable individual developmental variation.

SCAPULAE AND FORELIMBS. Scapulae and forelimb bones are illustrated in Fig. 8 (measurements, Table 5). The phalangeal formula (including the metacarpals) is I_2, II_{5-6}, III_5, IV_4, V_{3-4} compared with I_1, II_5, III_5, IV_4, V_3 in the specimen described by Omura et al. (1962).

DISCUSSION

The sperm whale was the most widely hunted cetacean in the 19th and 20th centuries. The question of possible sub-specific status, on the basis of osteological and external features, has interested researchers for more than a century (Flower,1869). Berzin (1971) noted: 'The only consistent difference found between populations is that animals from the southern hemisphere have a slightly longer caudal region than those from the northern hemisphere'. Clarke & Paliza (1972) concluded, on the basis of extensive material collected during whaling operations, that sperm whales from the SE Pacific, Japan, the Bonin I. and Durban are not different in their morphometry and accordingly, based on the method of body proportions, did not accept that there are northern and southern sub-species of the sperm whale.

The central epiphyses of the distal caudal vertebrae of QMJM11149 are almost completely fused and presumably further vertebral growth, if the animal had survived, would have occurred predominantly in the dorso-lumbar and proximal caudal vertebrae given the non-fusion of the central epiphyses at those levels (Fig. 5A-D). The MVL of QMJM11149 when compared with the slightly longer male from the Japanese coast (Fig. 6) does not demonstrate a proportional difference in caudal length. On the available osteological data, we are unable to detect any significant difference between the northern and southern hemisphere sperm whale populations.

ACKNOWLEDGEMENTS

Steve Van Dyck organised the retrieval of QMJM11149. Kylie and Paul Stumkat and Robert Wallace assisted with flensing. Their valuable assistance is much appreciated. Staff at the Luggage Point Wastewater Treatment Plant at Pinkenba kindly allowed us to store the skeleton there during cleansing and ensured its safety. Jeff Wright and Vincent Railton took the photographs.

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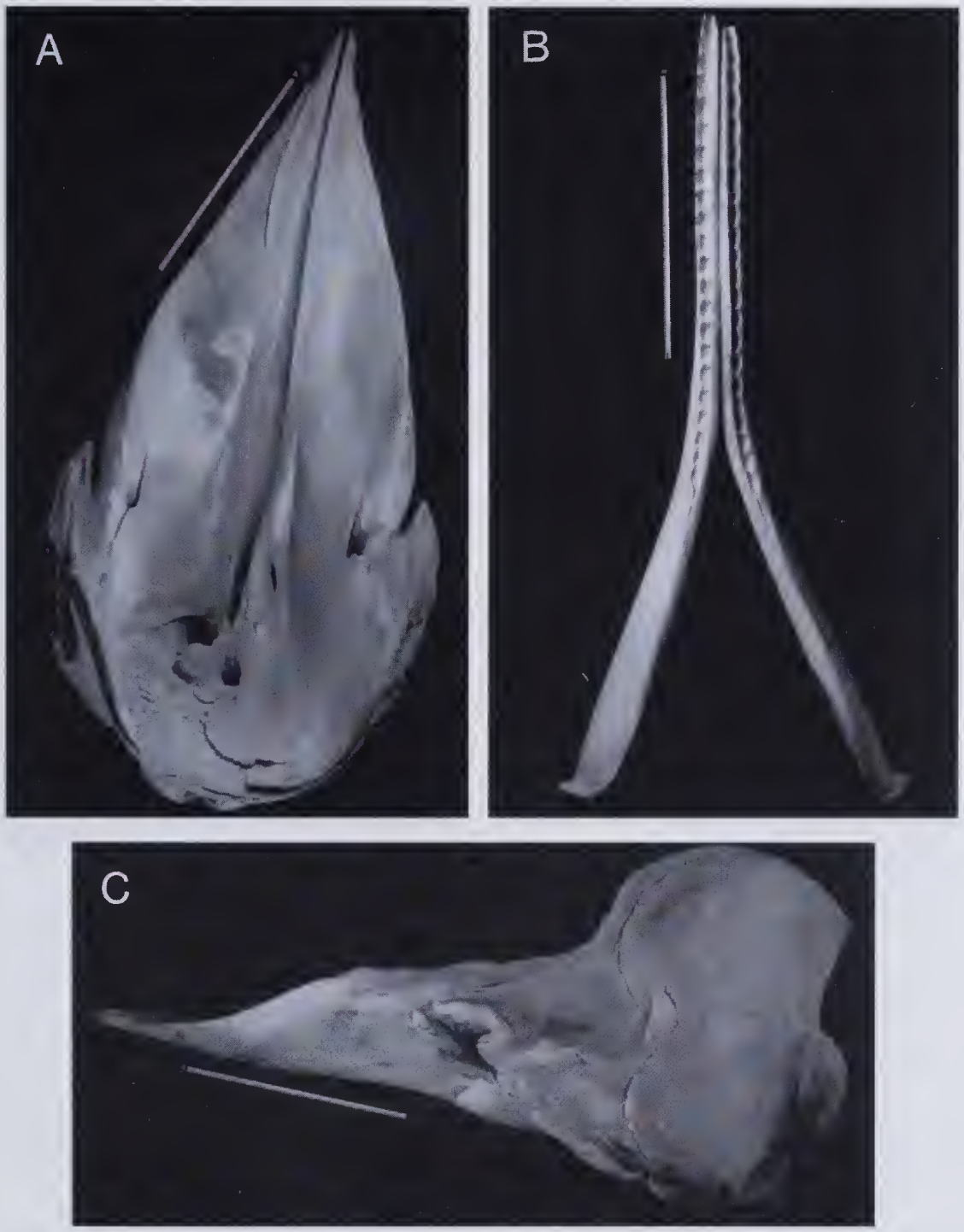

FIG. 3. QMJM11149. A, skull from dorsal aspect; B, mandible from dorsal aspect; C, skull from lateral aspect. (Scales = 1m)

TABLE 1. Mandibular and vestigial maxillary teeth measurements (mm) of QMJMI1149. B = broken, * = worn.

Mandib-ular Teeth	Length		Diameter of cavum dentis (antero-posterior)		Diameter of cavum dentis (transverse)	
	L	R	L	R	L	R
1	88	91*	26	20	17	22
2	88	102*	29	33	20	30
3	101	116	34	42	25	35
4	107	124	37	47	28	35
5	109	125	30	38	30	37
6	109	122	42	52	33	34
7	108	115	44	52	31	36
8	102	115	38	52	35	37
9	116	107	51	34	36	38
10	109	117*	35	53	34	37
11	114	109	50	30	37	38
12	114	112	51	37	30	38
13	116	116	55	30	39	38
14	115	114	53	49	38	35
15	118	95B	55	48	38	37
16	121	114	54	48	47	35
17	115	97B	50	34	38	35
18	116	103*	30	43	36	31
19	114	95*	48	35	35	27
20	124	108	35	38	36	30
21	111*	101	30	38	38	28
22	107	94	42	31	29	29
23	87	80*	20	31	49	18
Maxillary Teeth						
20	58		17		14	
25	46		15		12	
26	50		14		11	

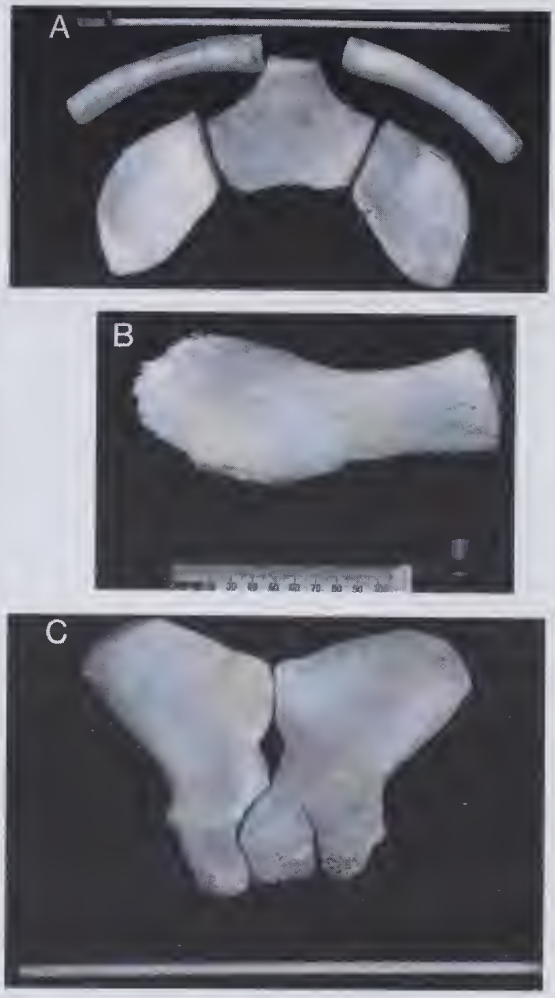

FIG. 4. QMJMI1149. A, hyoid components; stylohyals (uppermost), basihyoid (centre), thylohyals (lowermost) (scale = 1m). B, femur (scale in cm). C, sternum (scale = 1m).

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TABLE 2. Skull, mandibular and hyoid measurements (cm) of QMJM11149. * = damaged, # = damaged at tip.

Measurement	cm
Total (condylo-basal) length	326
Length of rostrum (median)	249
Breadth of rostrum at base	120
Breadth of rostrum at middle	86
Breadth of rostrum between antorbital notches	117
Depth of rostrum at middle	18
Breadth of premaxillae at middle of rostrum	23
Breadth of premaxillae in front of anterior nares	53
Greatest breadth of premaxillae opposite anterior nares	60
Least distance between the postero-dorsal margins of the premaxillary foramina	60
Least distance between the postero-dorsal margins of the premaxillary foramina	23
Least distance between the maxillary foramina and premaxillary foramina	L: 45
	R: 32
Greatest breadth of superior nares	27
Distance from tip of rostrum to anterior end of vomer	36
Distance from tip of rostrum to anterior margin of superior nares	L: 226
	R: 244
Distance from tip of rostrum to medial suture line of posterior end of pterygoid	257
Distance from tip of rostrum to occipito-frontal vertex	294
Distance from tip of rostrum to posterior median end of maxillary on palate	227
Distance from tip of rostrum to most anterior point of the palatines	227
Length of vomer visible on palate	142
Breadth across middle of orbits	144
Diameter of orbit (antero-posterior)	L: 14
	R: 14
Greatest breadth across supra-orbital plates of maxillae	137
Greatest breadth across post-orbital processes	147
Greatest breadth of cranium at parietal region in temporal fossae	114
Length of temporal fossae	L: 32
	R:*
Depth of temporal fossae	L: 14
	R: *
Breadth of occipital condyles	49
Breadth of foramen magnum	12
Length of occipital condyle	L:32
	R: 34
Height, vertex to inferior border of pterygoids	109
Depth of orbit	L: 14
	R: 14
Length of mandibular ramus	L: 269#
	R: 269#
Distance from anterior end of mandible to coronoid process	L: 242#
	R: 247#
Length of symphysis	L: 142
	R: 141
Distance from anterior end of mandible to posterior end of alveoli	L: 164
	R: 164
Greatest height of mandible at coronoid process	L: 43
	R: 42
Distance between mandibular condyles	111
Distance between ear bones	70
Breadth of posterior end of pterygoids	17
Breadth of anterior end of pterygoids	49
Length of malar bone	L: 41
	R: 41

Hyoid	Greatest Length	Greatest Breadth
Stylohyal, right	47	7
Stylohyal, left	47	7
Basihyoid	29	49
Thylohyal, right	40.5	24
Thylohyal, left	42	23

TABLE 3. Vertebral, chevron, femoral measurements (mm) and MVL of QMJM11149, MVL of the Japanese specimen. # = unable to calculate.

Vertebra No.	Greatest Breadth	Greatest Height	Centrum Breadth (a)	Centrum Height (b)	Centrum Length (c)	MVL JM11149 $(a \times b \times c)^{1/3}$	MVL Japanese specimen
C1	683	394	#	#	#	#	127
2-7	637	438	#	#	#	#	243
D1	437	414	237	171	109	164	208
2	436	151	203	109	126	169	190
3	409	471	200	193	127	170	197
4	391	478	196	189	132	170	185
5	384	480	190	181	140	169	186
6	363	479	190	176	145	169	186
7	335	494	197	183	148	175	197
8	323	499	198	185	162	181	193
9	378	508	195	185	170	183	190
10	479	541	202	186	177	188	212
11	520	545	210	203	189	203	221
L1	491	557	200	207	197	203	219
2	480	594	209	207	218	211	233
3	505	589	209	209	245	211	244
4	518	596	210	210	227	218	200
5	531	608	213	220	240	220	254
6	547	615	213	225	230	225	251
7	556	594	214	228	252	231	252
8	567	583	221	232	272	211	260
Ca1	561	589	227	233	258	239	273
2	554	588	236	239	279	251	276
3	535	572	242	243	291	258	276
4	490	550	253	245	200	253	279
5	531	525	252	211	282	258	281
6	373	482	250	245	276	257	277
7	320	425	235	237	247	200	265
8	268	384	232	230	233	232	258
9	237	357	215	222	225	221	241
10	221	325	205	220	212	212	230
11	212	287	198	213	186	190	204
12	203	244	188	200	169	182	173
13	185	200	172	170	118	151	135
14	153	152	142	130	83	115	115
15	151	130	125	112	79	103	104
16	151	125	109	109	74	90	90
17	140	113	85	90	79	81	80
18	121	109	85	80	64	76	76
19	102	85	74	85	55	64	66
20	82	73	65	54	49	56	56
21	85	81	35	37	64	52	53
22	54	56	37	30	10	37	42
23	35	30	33	10	27	30	35
24	29	23	21	10	10	49	20
25	14	13	12	10	10		

Chevron	Greatest Length	Greatest Width
1	402	100
2	400	187
3	393	195
4	374	182
5	340	195
6	280	185
7	242	100
8	100	100
9	100	150
10	123	100
10	100	10
Femur	179	10

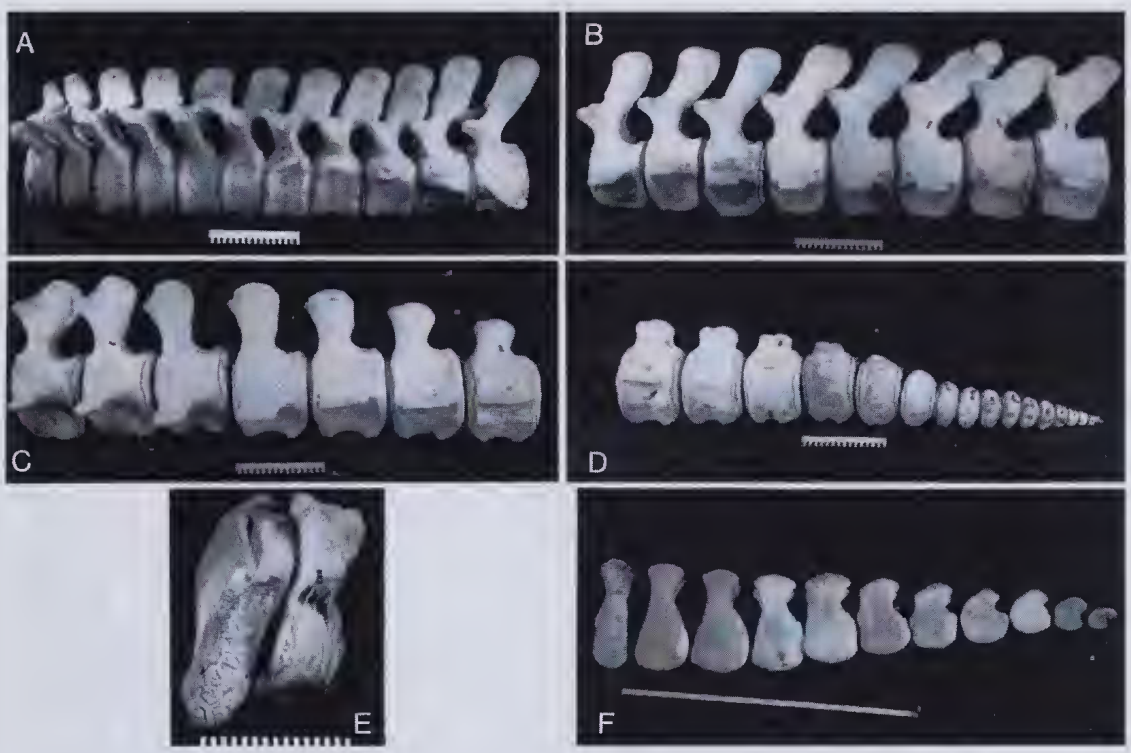

FIG. 5. Vertebrae of QMJM11149 from lateral aspect; A, dorsal; B, lumbar; C & D, caudal; E, cervical; (scales in cm). F, chevrons (scale = 1m).

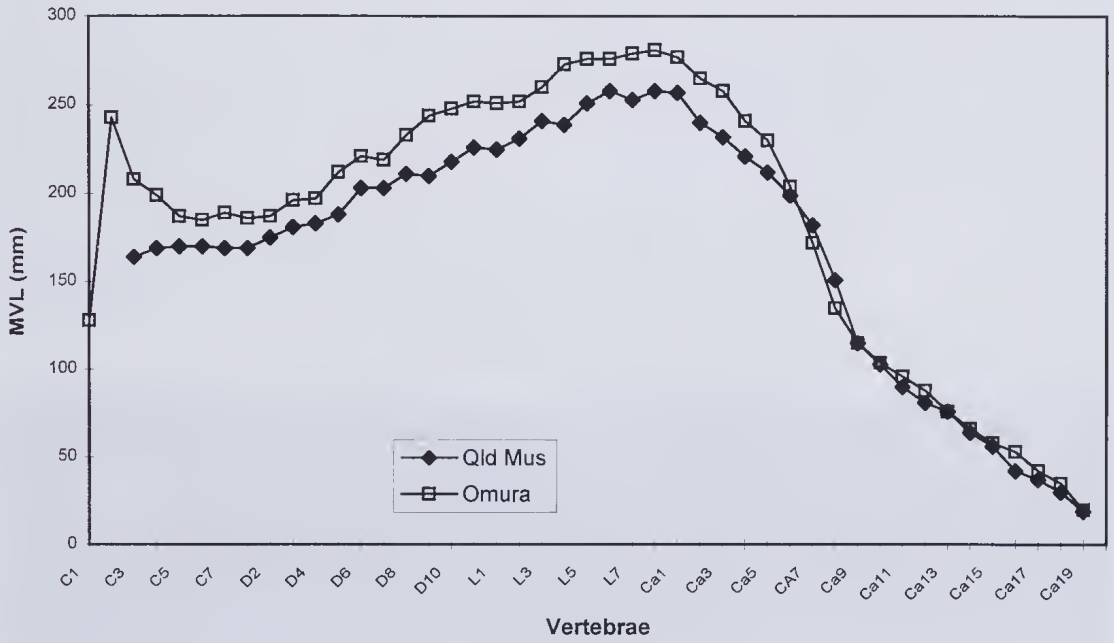

FIG. 6. Comparison between mean vertebral lengths (MVL) of QMJM11149 and the Japanese specimen (Omura et al., 1962).

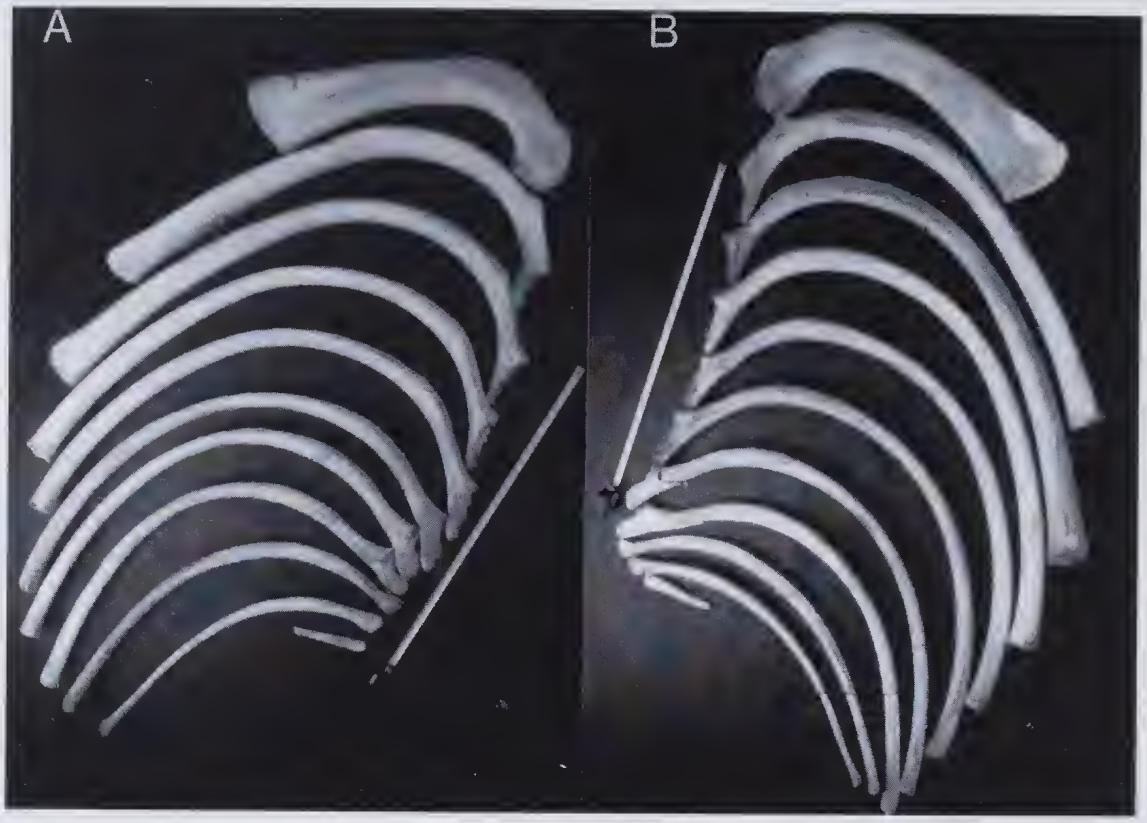

FIG. 7. Ribs of QMJM11149; A, left; B, right. (Scale = 1m)

TABLE 4. Rib and sternal measurements (cm) of QMJM11149. * = damaged.

Rib	Straight Length		Rib	Straight Length	
	Left	Right		Left	Right
1	93	94	8	123	114*
2	129	128	9	112	110
3	142	141	10	95	94
4	142	139	11	22	23
5	135	133	Sternum	Greatest Length	Greatest Width
6	135	130	Left side	58	42
7	128	126*	Right side	54	42

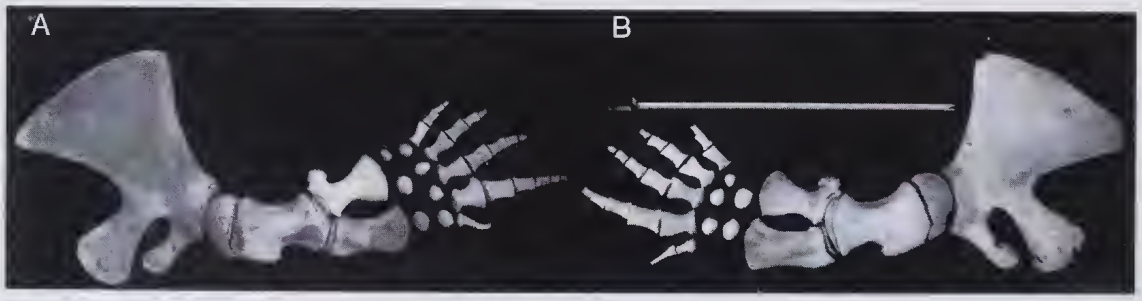

FIG. 8. Scapulae and forelimb bones of QMJM11149; A, left; B, right; (scale = 1m).

TABLE 5. Scapular and forelimb measurements (mm) of QMJM11149. * = possibly missing.

Scapula		
	Left	Right
Greatest Breadth	545	550
Greatest Length	615	605

	Humerus, Radius, Ulna			
	Width at centre		Length	
	Left	Right	Left	Right
Humerus	130	130	370	367
Radius	114	93	258	256
Ulna	81	88	244	234

Length of Phalanges										
Phalanx	Left					Right				
	I	II	III	IV	V	V	II	III	IV	I
I	63	99	99	99	99	61	101	103	63	73
2	51	88	74	65	52	88	93	99	69	53
3		67	57	48	30		76	62	51	33
4		45	38	31	18		49	39	33	*
5		30	24				33	27		
6		14								